INTERNATIONAL STANDARD

ISO 148-2

Third edition
2016-10-15

Metallic materials — Charpy pendulum impact test —

Part 2: Verification of testing machines

Matériaux métalliques — Essai de flexion par choc sur éprouvette Charpy —

Partie 2: Vérification des machines d'essai (mouton-pendule)

Reference number
ISO 148-2:2016(E)

© ISO 2016



COPYRIGHT PROTECTED DOCUMENT

© ISO 2016, Published in Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

Contents

Page

Foreword ... **iv**

Introduction ... **v**

1 Scope ... **1**

2 Normative references ... **1**

3 Terms and definitions ... **2**
3.1 Definitions pertaining to the machine ... 2
3.2 Definitions pertaining to energy ... 3
3.3 Definitions pertaining to test pieces ... 4

4 Symbols and abbreviated terms ... **4**

5 Testing machine ... **6**

6 Direct verification ... **6**
6.1 General ... 6
6.2 Foundation/installation ... 6
6.3 Machine framework ... 7
6.4 Pendulum ... 8
6.5 Anvil and supports ... 11
6.6 Indicating equipment ... 12

7 Indirect verification by use of reference test pieces ... **13**
7.1 Reference test pieces used ... 13
7.2 Absorbed energy levels ... 13
7.3 Requirements for reference test pieces ... 13
7.4 Limited direct verification ... 13
7.5 Bias and repeatability ... 13
7.5.1 Repeatability ... 13
7.5.2 Bias ... 14

8 Frequency of verification ... **14**

9 Verification report ... **14**
9.1 General ... 14
9.2 Direct verification ... 15
9.3 Indirect verification ... 15

10 Uncertainty ... **15**

Annex A (informative) **Measurement uncertainty of the result of the indirect verification of a Charpy pendulum impact machine** ... **21**

Annex B (informative) **Measurement uncertainty of the results of the direct verification of a Charpy pendulum impact testing machine** ... **25**

Annex C (informative) **Direct method of verifying the geometric properties of pendulum impact testing machines using a jig** ... **32**

Bibliography ... **38**

© ISO 2016 – All rights reserved

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

The committee responsible for this document is ISO/TC 164, *Mechanical testing of metals*, Subcommittee SC 4, *Toughness testing — Fracture (F), Pendulum (P), Tear (T)*.

This third edition cancels and replaces the second edition (ISO 148-2:2008), which has been technically revised.

ISO 148 consists of the following parts, under the general title *Metallic materials — Charpy pendulum impact test*:

— *Part 1: Test method*

— *Part 2: Verification of testing machines*

— *Part 3: Preparation and characterization of Charpy V-notch test pieces for indirect verification of pendulum impact machines*

© ISO 2016 – All rights reserved

Introduction

The suitability of a pendulum impact testing machine for acceptance testing of metallic materials has usually been based on a calibration of its scale and verification of compliance with specified dimensions, such as the shape and spacing of the anvils supporting the specimen. The scale calibration is commonly verified by measuring the mass of the pendulum and its elevation at various scale readings. This procedure for evaluation of machines had the distinct advantage of requiring only measurements of quantities that could be traced to national standards. The objective nature of these traceable measurements minimized the necessity for arbitration regarding the suitability of the machines for material acceptance tests.

However, sometimes two machines that had been evaluated by the direct-verification procedures described above, and which met all dimensional requirements, were found to give significantly different impact values when testing test pieces of the same material.

This difference was commercially important when values obtained using one machine met the material specification, while the values obtained using the other machine did not. To avoid such disagreements, some purchasers of materials added the requirement that all pendulum impact testing machines used for acceptance testing of material sold to them are to be indirectly verified by testing reference test pieces supplied by them. A machine was considered acceptable only if the values obtained using the machine agreed, within specified limits, with the value furnished with the reference test pieces.

This part of ISO 148 describes both the original direct verification and the indirect verification procedures.

© ISO 2016 – All rights reserved

Metallic materials — Charpy pendulum impact test —

Part 2: Verification of testing machines

1 Scope

This part of ISO 148 covers the verification of pendulum-type impact testing machines, in terms of their constructional elements, their overall performance and the accuracy of the results they produce. It is applicable to machines with 2 mm or 8 mm strikers used for pendulum impact tests carried out, for instance, in accordance with ISO 148-1.

It can be applied to pendulum impact testing machines of various capacities and of different design.

Impact machines used for industrial, general or research laboratory testing of metallic materials in accordance with this part of ISO 148 are referred to as industrial machines. Those with more stringent requirements are referred to as reference machines. Specifications for the verification of reference machines are found in ISO 148-3.

This part of ISO 148 describes two methods of verification.

a) The direct method, which is static in nature, involves measurement of the critical parts of the machine to ensure that it meets the requirements of this part of ISO 148. Instruments used for the verification and calibration are traceable to national or international standards.

b) The indirect method, which is dynamic in nature, uses reference test pieces to verify points on the measuring scale for absorbed energy. The requirements for the reference test pieces are found in ISO 148-3.

A pendulum impact testing machine is not in compliance with this part of ISO 148 until it has been verified by both the direct and indirect methods and meets the requirements of Clause 6 and Clause 7.

This part of ISO 148 describes how to assess the different components of the total energy absorbed in fracturing a test piece. This total absorbed energy consists of

— the energy needed to fracture the test piece itself, and

— the internal energy losses of the pendulum impact testing machine performing the first half-cycle swing from the initial position.

NOTE Internal energy losses are due to the following:

— air resistance, friction of the bearings of the rotation axis and of the indicating pointer of the pendulum which can be determined by the direct method (see 6.4.5);

— shock of the foundation, vibration of the frame and pendulum for which no suitable measuring methods and apparatus have been developed.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 148-1, *Metallic materials — Charpy pendulum impact test — Part 1: Test method*

© ISO 2016 – All rights reserved

ISO 148-3, *Metallic materials — Charpy pendulum impact test — Part 3: Preparation and characterization of Charpy V-notch test pieces for indirect verification of pendulum impact machines*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1 Definitions pertaining to the machine

3.1.1
anvil
portion of the machine that serves to properly position the test piece for impact with respect to the striker and the test piece supports, and supports the test piece under the force of the strike

3.1.2
base
part of the framework of the machine located below the horizontal plane of the supports

3.1.3
centre of percussion
point in a body at which, on striking a blow, the percussive action is the same as if the whole mass of the body were concentrated at the point

Note 1 to entry: When a simple pendulum delivers a blow along a horizontal line passing through the centre of percussion, there is no resulting horizontal reaction at the axis of rotation.

Note 2 to entry: See Figure 4.

3.1.4
centre of strike
point on the striking edge of the pendulum at which, in the free hanging position of the pendulum, the vertical edge of the striker meets the upper horizontal plane of a test piece of half standard thickness (i.e. 5 mm) or equivalent gauge bar resting on the test piece supports

Note 1 to entry: See Figure 4.

3.1.5
industrial machine
pendulum impact machine used for industrial, general or most research-laboratory testing of metallic materials

Note 1 to entry: Industrial machines are not used to establish reference values, unless they also meet the requirements of a reference pendulum (see ISO 148-3).

Note 2 to entry: Industrial machines are verified using the procedures described in this part of ISO 148.

3.1.6
reference machine
pendulum impact testing machine used to determine certified values for batches of *reference test pieces* (3.3.4)

Note 1 to entry: Reference machines are verified using the procedures described in ISO 148-3.

3.1.7
striker
portion of the pendulum that contacts the test piece

Note 1 to entry: The edge that actually contacts the test piece has a radius of 2 mm (the 2 mm striker) or a radius of 8 mm (the 8 mm striker).

Note 2 to entry: See Figure 2.

© ISO 2016 – All rights reserved

3.1.8
test piece supports
portion of the machine that serves to properly position the test piece for impact with respect to the *centre of percussion* (3.1.3) of the pendulum, the *striker* (3.1.7) and the *anvils* (3.1.1)

Note 1 to entry: See Figure 2 and Figure 3.

3.2 Definitions pertaining to energy

3.2.1
total absorbed energy
K_T
total absorbed energy required to break a test piece with a pendulum impact testing machine, which is not corrected for any losses of energy

Note 1 to entry: It is equal to the difference in the *potential energy* (3.2.2) from the starting position of the pendulum to the end of the first half swing during which the test piece is broken (see 6.3).

3.2.2
initial potential energy
potential energy
K_P
potential energy of the pendulum hammer prior to its release for the impact test, as determined by direct verification

Note 1 to entry: See 6.4.2.

3.2.3
absorbed energy
K
energy required to break a test piece with a pendulum impact testing machine, after correction for friction as defined in 6.4.5

Note 1 to entry: The letter V or U is used to indicate the notch geometry, which is *KV* or *KU*. The number 2 or 8 is used as a subscript to indicate striker radius, for example KV_2.

3.2.4
calculated energy
K_{calc}
energy calculated from values of angle, length and force measured during direct verification

3.2.5
nominal initial potential energy
nominal energy
K_N
energy assigned by the manufacturer of the pendulum impact testing machine

3.2.6
indicated absorbed energy
K_S
energy indicated by the display/dial of the testing machine, which may or may not need to be corrected for friction and air resistance to determine the *absorbed energy*, *K* (3.2.3)

3.2.7
reference absorbed energy
K_R
certified value of *absorbed energy* (3.2.3) assigned to the *reference test pieces* (3.3.4) used to verify the performance of pendulum impact machines

© ISO 2016 – All rights reserved

3.3 Definitions pertaining to test pieces

3.3.1
width
W
distance between the notched face and the opposite face

Note 1 to entry: In previous versions of the ISO 148 series (prior to 2016), the distance between the notched face and the opposite face was specified as "height". Changing this dimension to "width" makes ISO 148-2 consistent with the terminology used in other ISO fracture standards.

3.3.2
thickness
B
dimension perpendicular to the *width* (3.3.1) and parallel to the notch

Note 1 to entry: In previous versions of the ISO 148 series (prior to 2016), the dimension perpendicular to the width that is parallel to the notch was specified as "width". Changing this dimension to "thickness" makes ISO 148-2 consistent with the terminology used in other ISO fracture standards.

3.3.3
length
L
largest dimension perpendicular to the notch

3.3.4
reference test piece
impact test piece used to verify the suitability of a pendulum impact testing machine by comparing the *indicated absorbed energy* (3.2.3) measured by that machine with the *reference absorbed energy* (3.2.7) associated with the test pieces

Note 1 to entry: Reference test pieces are prepared in accordance with ISO 148-3.

4 Symbols and abbreviated terms

Table 1 — Symbols/abbreviated terms and their designations and units

Symbol/ abbreviated term[a]	Unit	Designation
B_V	J	Bias of the pendulum impact machine as determined through indirect verification
b	J	Repeatability
F	N	Force exerted by the pendulum when measured at a distance l_2
F_g	N	Force exerted by the pendulum due to gravity
g	m/s2	Acceleration due to gravity
GUM	—	Guide to the expression of uncertainty in measurement[1]
h	m	Height of fall of pendulum
H_1	m	Height of rise of pendulum
K	J	Absorbed energy (expressed as KV_2, KV_8, KU_2, KU_8, to identify specific notch geometries and the radius of the striking edge)
K_T	J	Total absorbed energy
K_S	J	Indicated absorbed energy
K_{calc}	J	Calculated energy
KV_R	J	Certified *KV* value of the reference material used in the indirect verification

[a] See Figure 4.

© ISO 2016 – All rights reserved